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CERTIFICATION OF FACSIMILE TRANSMISSION
UNDER 37 CFR § 1.8

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Amelia Tauchen

Attorney's Docket No.: 5649-1265

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Jung-hun Seo et al.
Serial No.: 10/796,437
Filed: March 9, 2004
For: Methods of Forming a Conductive Structure in an Integrated Circuit Device

Confirmation No. 1822
Group Art Unit: 2822
Examiner: Christy L. Novacek

ATTACHED:

Faxcover	**1 page**
Appeal Brief Transmittal	**1 page**
Appeal Brief	**16 pages**
TOTAL	**18 pages**

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Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF APPEAL BRIEF
(PATENT APPLICATION--37 C.F.R. § 41.37)

1. Transmitted herewith is the APPEAL BRIEF for the above-identified application, pursuant to the "Notice of Appeal to the Board of Patent Appeals and Interferences" filed January 8, 2007 and the "Notice of Panel Decision from Pre-Appeal Brief Review" mailed February 15, 2007.

2. This application is filed on behalf of
☐ a small entity.

3. Pursuant to 37 C.F.R. § 41.20(b)(2), the fee for filing the Appeal Brief is:
☐ small entity $250.00
☒ other than small entity $500.00

Appeal Brief fee due $500.00

☒ Please charge Deposit Account No. 50-0220 in the amount $500.00

☒ Any additional fee or refund may be charged to Deposit Account No. 50-0220.

Respectfully submitted,

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APPELLANTS' BRIEF ON APPEAL UNDER 37 C.F.R. §41.37

Sir:

This Appeal Brief is filed pursuant to the "Notice of Appeal to the Board of Patent Appeals and Interferences" filed January 8, 2007 and the "Notice of Panel Decision from Pre-Appeal Brief Review" mailed February 15, 2007.

Real Party In Interest

The real party in interest is assignee Samsung Electronics Co., Ltd., 416 Maetan-dong, Paldal-gu, Suwon-City, Kyungki-do, Republic of Korea.

Related Appeals and Interferences

Appellants are aware of no appeals or interferences that would be affected by the present appeal.

Status of Claims

Appellants appeal the rejection of Claims 1 - 38 as set forth in the Final Office Action of September 8, 2006 (hereinafter "Final Action"), which as of the filing date of this Brief remain under consideration. Claims 1 - 38 stand rejected. Appellants submit that the claims involved in the appeal are Claims 1 - 38 as a reversal of the rejection of independent Claims 1 and 24 is requested in the present appeal and a reversal of the rejection of dependent Claims 2 - 23 and 25 - 38 is also requested based on the reversal of the rejection of the independent claims. Accordingly, Claims 1 - 38 as included in Appellants' response to the Office Action of December 14, 2005 are attached hereto as Appendix A.

Status of Amendments

No amendment has been filed in the present case in response to the Final Action.

Summary of Claimed Subject Matter

Independent Claim 1 is directed to a method of forming a conductive structure, comprising providing a substrate (Specification, page 6, line 24 - page 7, line 1; FIG. 3, block 100; FIG. 13, substrate 10), forming a lower conductive pattern on the substrate (Specification, page 6, line 24 - page 7, line 1; FIG. 3, block 100; FIG. 13, pattern 20), forming a barrier metal layer on the lower conductive pattern (Specification, page 7, lines 4 - 5; FIG. 3, block 110; FIG. 13, layer 40), flushing the barrier metal layer with a gas that comprises a halogen group gas (Specification, page 7, lines 5 - 6, page 8, lines 3 - 12; FIG. 3, block 130),and forming an upper conductive layer on the barrier metal layer (Specification, page 7, lines 6 - 7; FIG. 3, block 150; FIG. 13, layer 50).

Independent Claim 24 is directed to a method of forming a conductive structure of a semiconductor device, comprising forming a lower conductive pattern on a semiconductor substrate (Specification, page 6, line 24 - page 7, line 1; FIG. 3, block 100; FIG. 13, pattern 20), depositing a barrier metal layer on the semiconductor substrate with the lower conductive pattern using a metal organic precursor (Specification, page 7, lines 4 - 5 and 15 - 18; FIG. 3, block 110; FIG. 13, layer 40), flushing the deposited barrier metal layer (Specification, page 7, lines 5 - 6, page 8, lines 3 - 12; FIG. 3, block 130), and forming an upper conductive layer on the

semiconductor substrate with the flushed barrier metal layer (Specification, page 7, lines 6 - 7; FIG. 3, block 150; FIG. 13, layer 50), wherein the step of flushing the barrier metal layer uses a processing gas including $TiCl_4$ gas and argon gas (Specification, page 8, lines 3 - 12).

Grounds of Rejection to be Reviewed on Appeal

Claims 1 - 4, 7, 9 - 30, 32, and 36 - 38 stand rejected under 35 U.S.C. §102(b) as being anticipated by U. S. Patent No. 6,838,772 to Saitoh et al. (hereinafter "Saitoh").

Claims 5, 6, 8, 31, and 33 - 35 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Saitoh.

Argument

I. Introduction to 35 U.S.C. §102 Analysis

Under 35 U.S.C. § 102, "a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." M.P.E.P. § 2131 (quoting *Verdegaal Bros. v. Union Oil Co.*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987)). "Anticipation under 35 U.S.C. § 102 requires the disclosure in a single piece of prior art of each and every limitation of a claimed invention." *Apple Computer Inc. v. Articulate Sys. Inc.*, 57 U.S.P.Q.2d 1057, 1061 (Fed. Cir. 2000). "The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.'" M.P.E.P. § 2112 (citations omitted).

A finding of anticipation further requires that there must be no difference between the claimed invention and the disclosure of the cited reference as viewed by one of ordinary skill in the art. *See Scripps Clinic & Research Foundation v. Genentech Inc.*, 927 F.2d 1565, 1576, 18 U.S.P.Q.2d 1001, 1010 (Fed. Cir. 1991). In particular, the Court of Appeals for the Federal

Circuit held that a finding of anticipation requires absolute identity for each and every element set forth in the claimed invention. *See Trintec Indus. Inc. v. Top-U.S.A. Corp.*, 63 U.S.P.Q.2d 1597 (Fed. Cir. 2002). Additionally, the cited prior art reference must be enabling, thereby placing the allegedly disclosed matter in the possession of the public. *In re Brown*, 329 F.2d 1006, 1011, 141 U.S.P.Q. 245, 249 (C.C.P.A. 1964). Thus, the prior art reference must adequately describe the claimed invention so that a person of ordinary skill in the art could make and use the invention.

Appellants respectfully submit that the pending independent claims are patentable over the cited reference for at least the reason that the cited reference does not disclose or suggest, either alone or in combination, each of the recitations of the independent claims. The patentability of the pending claims is discussed in detail hereinafter.

A. Independent Claims 1 and 24 are Patentable

Independent Claims 1 and 24 stand rejected under 35 U.S.C. §102(b) as being anticipated by Saitoh. (Final Action, page 2). Independent Claim 1 recites, in part:

> ...
> forming a barrier metal layer on the lower conductive pattern;
> flushing the barrier metal layer with a gas that comprises a halogen group gas;
> ...

Similarly, independent Claim 24 recites, in part:

> ...
> depositing a barrier metal layer on the semiconductor substrate with the lower conductive pattern using a metal organic precursor;
> flushing the deposited metal layer; and
> forming an upper conductive layer on the semiconductor substrate with the flushed barrier metal layer,
> wherein the step of flushing the barrier metal layer uses a processing gas including $TiCl_4$ gas and argon gas.

Thus, according to independent Claims 1 and 24 a barrier metal layer is flushed using a halogen gas generally or, in particular (Claim 24), by using the halogen gas $TiCl_4$ along with argon gas.

In rejecting independent Claims 1 and 24, the Final Action cites the description accompanying FIGS. 11 - 14 of Saitoh at columns 19 - 22. In reviewing this passage, however, Appellants are unable to find any mention of using a halogen group gas or a processing gas that includes ***both*** $TiCl_4$ gas and argon gas for flushing a barrier metal layer. Saitoh describes the use of $TiCl_4$ gas to form the conductor film 17b2, but not as part of a flushing operation on any of the conductor film 17b layers. (Saitoh, col. 21, lines 12 - 59). Saitoh does state that argon gas can be used to clean the surface of a $TiCl_4$ layer as part of forming the conductor film 17b2 (Saitoh, col. 21, lines 38 - 42). Argon gas, however, is not a halogen group gas and the $TiCl_4$ gas used to form the $TiCl_4$ layer is not used as part of the cleaning/flushing process.

In response to these arguments, the Final Action states that "[t]he term 'flushing' has not been given any special meaning or definition by Applicant..." (Final Action, page 5). Appellants respectfully disagree. The Specification at page 12, lines 7 - 13 states:

> Some embodiments of the present invention provide a method for forming a conductive structure that includes flushing a barrier metal layer formed by using metal organic chemical vapor deposition or atomic layer deposition. The barrier metal layer can be formed at a relatively low temperature by using metal organic chemical vapor deposition or atomic layer deposition. The flushing process for cleaning the surface of the barrier metal layer may reduce problems resulting from an insufficient removal of carbon and outgassing oxygen. (Emphasis added).

As highlighted above, the Specification makes clear that "flushing" refers to a "cleaning" operation. The Final Action argues that Saitoh's teachings regarding the formation of the conductor film 17b2 by depositing a $TiCl_4$ layer on the sidewalls and bottom surface of the through-hole 19 using $TiCl_4$ gas (Saitoh, col. 21, lines 34 - 38) corresponds to the flushing recitation of independent Claims 1 and 24. (Final Action, page 6). But as explained above, a flushing operation is a cleaning operation. The deposition of a $TiCl_4$ layer in the through-hole 19 is part of the formation of the TiSiN film 17b2 and does not involve a cleaning operation;

therefore, the deposition of the $TiCl_4$ layer cannot correspond to the flushing recitation of independent Claims 1 and 24.

In response to this analysis, the "Notice of Panel Decision from Pre-Appeal Brief Review" states in a "Response to Arguments" section that the deposition of the $TiCl_4$ layer described in column 21 of Saitoh to form the conductor film 17b2 inherently involves a flushing or cleaning operation. With respect to inherency, MPEP Section 2112, part IV states:

> The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. *In re Rijckaert*, 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993) (reversed rejection because inherency was based on what would result due to optimization of conditions, not what was necessarily present in the prior art); *In re Oelrich*, 666 F.2d 578, 581-82, 212 USPQ 323, 326 (CCPA 1981). "To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.' " *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999)

Appellants respectfully submit that Saitoh fails to make clear that deposition of the $TiCl_4$ layer to form the conductor film 17b2 **necessarily** results in a flushing or cleaning operation on the conductor film 17b1 as required by MPEP Section 2112. As discussed above, Saitoh explains that argon gas is used to clean the $TiCl_4$ layer 17b2 after it is formed (Saitoh, col. 21, lines 38 - 43) but makes no mention or suggestion that the deposition of a $TiCl_4$ layer necessarily flushes or cleans the surface on which the $TiCl_4$ layer is formed.

For the sake of argument, however, even if the allegation that deposition of the $TiCl_4$ layer to form the conductor film 17b2 as described in column 21 of Saitoh results in a flushing or cleaning operation on the conductor film 17b1 were accepted to be true, Saitoh's teachings still do not anticipate the recitations of independent Claims 1 and 24. Independent Claim 1 states that a halogen group gas is used to flush barrier metal layer. The halogen group gases comprise fluorine, chlorine, bromine, and iodine gas. $TiCl_4$ gas, which is used to form the conductor film

17b2 of Saitoh, is not a halogen group gas. Saitoh does state that argon gas can be used to clean the surface of the $TiCl_4$ layer as part of forming the conductor film 17b2 (Saitoh, col. 21, lines 38 - 42). Argon gas, however, is not a halogen group gas. Independent Claim 24 requires ***both*** argon gas and $TiCl_4$ gas be used as the processing gas for the flushing operation. As explained at column 21, lines 34 - 43, Saitoh does not describe the use of a single processing gas that includes both argon gas and $TiCl_4$ gas, but instead describes the use of $TiCl_4$ gas to form a $TiCl_4$ layer, which is then subsequently cleaned using argon gas. According to Saitoh, the $TiCl_4$ gas and the argon gas are not used together.

For at least the foregoing reasons, Appellants submits that independent Claims 1 and 24 are patentable over the cited reference and that dependent Claims 2 - 23 and 25 - 38 are patentable at least by virtue of their depending from an allowable claim. Accordingly, Appellants respectfully request that the rejection of Claims 1 - 38 be reversed based on the failure of the Examiner to establish a prima facie case of anticipation under 35 U.S.C. §102 for at least these reasons.

B. Dependent Claims 5, 6, 8, 31, and 33 - 35 are Patentable

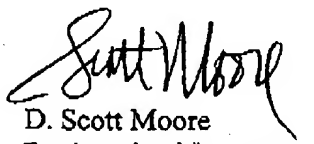
Dependent Claims 5, 6, 8, 31, and 33 - 35 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Saitoh. Dependent Claims 5, 6, 8, 31, and 33 - 35 each depend from one of the independent Claims 1 and 24, which Appellants submit are patentable for at least the reasons discussed above in Section IA. Appellants submit that dependent Claims 5, 6, 8, 31, and 33 - 35 are patentable over the cited references at least by virtue of their depending an allowable claim. *Ex parte Ligh*, 159 U.S.P.Q. (BNA) 61, 62 (Bd. App. 1967). Accordingly, Appellants respectfully request that the rejection of Claims 5, 6, 8, 31, and 33 - 35 be reversed based on the failure of the Examiner to establish a prima facie case of obviousness under 35 U.S.C. §103 for at least these reasons.

II. Conclusion

In summary, Appellants respectfully submit that, with respect to Claims 1 - 38, the cited reference does not teach all of the recitations of the claims for at least the reasons discussed

above. Accordingly, Appellants respectfully request reversal of the rejection of Claims 1 - 38 based on the cited reference.

Respectfully submitted,



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APPENDIX A

1. (Original) A method of forming a conductive structure, comprising:
providing a substrate;
forming a lower conductive pattern on the substrate;
forming a barrier metal layer on the lower conductive pattern;
flushing the barrier metal layer with a gas that comprises a halogen group gas; and
forming an upper conductive layer on the barrier metal layer.

2. (Original) The method of Claim 1, wherein the gas further comprises a transition metal.

3. (Original) The method of Claim 1, wherein the gas further comprises helium, neon, argon, hydrogen, and/or nitrogen.

4. (Original) The method of Claim 1, wherein flushing the barrier metal layer comprises flushing the barrier metal layer at a temperature of about 200° C to about 500° C.

5. (Original) The method of Claim 1, wherein flushing the barrier metal layer comprises flushing the barrier metal layer with argon gas with a flux of about 500 sccm to about 10000 sccm and $TiCl_4$ gas with a flux of about 1 sccm to about 100 sccm at a temperature of about 300° C to about 450° C.

6. (Original) The method of Claim 1, wherein flushing the barrier metal layer comprises flushing the barrier metal layer at a pressure of about 1 torr to about 100 torr for about 1 sec to about 10 minutes.

7. (Original) The method of Claim 1, further comprising:
degassing the barrier metal layer before flushing the barrier metal layer.

8. (Original) The method of Claim 7, wherein degassing the barrier metal layer comprises degassing the barrier metal layer using an inert gas at a temperature of about 200° C to about 500° C and a pressure of about 1 mTorr to about 100 Torr.

9. (Original) (Original) The method of Claim 7, wherein the barrier metal layer is a first barrier metal layer, the method further comprising:

forming a second barrier metal layer on the first barrier metal layer before forming the upper conductive layer.

10. (Original) The method of Claim 1, wherein the barrier metal layer is a first barrier metal layer, the method further comprising:

forming a second barrier metal layer on the first barrier metal layer before forming the upper conductive layer.

11. (Original) The method of Claim 10, wherein forming the second barrier metal layer comprises forming the second barrier metal layer using physical vapor deposition including sputtering.

12. (Original) The method of Claim 10, wherein the second barrier metal layer comprises titanium nitride, titanium silicon nitride, tantalum silicon nitride, and/or tantalum nitride.

13. (Original) The method of Claim 1, wherein forming the barrier metal layer comprises forming the barrier metal layer using atomic layer deposition.

14. (Original) The method of Claim 13, wherein forming the barrier metal layer using atomic layer deposition and flushing the barrier metal layer are performed at least twice.

15. (Original) The method of Claim 13, further comprising:

degassing the barrier metal layer before flushing the barrier metal layer.

16. (Original) The method of Claim 15, wherein forming the barrier metal layer using atomic layer deposition, degassing the barrier metal layer, and flushing the barrier metal layer are performed at least twice.

17. (Original) The method of Claim 15, wherein the barrier metal layer is a first barrier metal layer, the method further comprising:

forming a second barrier metal layer on the first barrier metal layer before forming the upper conductive layer.

18. (Original) The method of Claim 1, wherein the lower conductive pattern comprises tungsten, aluminum, polysilicon, copper, titanium, titanium nitride, tantalum, tantalum silicon nitride, and/or tantalum nitride.

19. (Original) The method of Claim 1, wherein the barrier metal layer comprises titanium nitride, titanium silicon nitride, tantalum silicon nitride, and/or tantalum nitride.

20. (Original) The method of Claim 1, wherein forming the barrier metal layer comprises forming the barrier metal layer using chemical vapor deposition with a metal organic precursor.

21. (Original) The method of Claim 1, wherein the upper conductive layer comprises tungsten, aluminum, polysilicon, and/or copper.

22. (Original) The method of Claim 1, further comprising:

treating the barrier metal layer with plasma before flushing the barrier metal layer.

23. (Original) The method of Claim 1, wherein the plasma comprises a processing gas that comprises hydrogen and/or nitrogen.

24. (Original) A method of forming a conductive structure of a semiconductor device, comprising:

forming a lower conductive pattern on a semiconductor substrate;

depositing a barrier metal layer on the semiconductor substrate with the lower conductive pattern using a metal organic precursor;

flushing the deposited barrier metal layer; and

forming an upper conductive layer on the semiconductor substrate with the flushed barrier metal layer,

wherein the step of flushing the barrier metal layer uses a processing gas including $TiCl_4$ gas and argon gas.

25. (Original) The method of Claim 24, wherein the barrier metal layer comprises titanium nitride (TiN), titanium silicon nitride (TiSiN), tantalum silicon nitride (TaSiN) and/or tantalum nitride (TaN).

26. (Original) The method of Claim 24, wherein the metal organic precursor is TDEAT or TDMAT.

27. (Original) The method of Claim 24, wherein the barrier metal layer is formed using a metal organic chemical vapor deposition (MO-CVD) or an atomic layer deposition (ALD) process.

28. (Original) The method of Claim 27, wherein the ALD process comprises a purging process using nitrogen (N_2), hydrogen (H_2), ammonia (NH_3) and/or titan tetrachloride ($TiCl_4$) as a purging gas.

29. (Original) The method of Claim 24, wherein forming the barrier metal layer further comprises plasma treatment.

30. (Original) The method of Claim 29, wherein the plasma treatment uses a processing gas comprising nitrogen and/or hydrogen gases.

31. (Original) The method of Claim 24, further comprising degassing the barrier metal layer at an inert gas ambience before flushing the barrier metal layer,

wherein the degassing step is performed at a temperature of about 200°C to 500°C under a pressure of about 1 mTorr to 100 Torr.

32. (Original) The method of Claim 24, wherein flushing the barrier metal layer is performed at a temperature of about 200°C to 500°C.

33. (Original) The method of Claim 24, wherein the argon gas is provided with a flux of about 500sccm to 10000sccm, and the $TiCl_4$ gas is provided with a flux of about 1sccm to 100sccm.

34. (Original) The method of Claim 24, wherein flushing the barrier metal layer is performed under a pressure of about 1 torr to 100 torr.

35. (Original) The method of Claim 24, wherein flushing the barrier metal layer is performed for about 1sec to 10min.

36. (Original) The method of Claim 24, wherein the barrier metal layer is a first barrier metal layer, the method further comprising:

forming a second barrier metal layer after flushing the first barrier metal layer,

wherein the second barrier metal layer is formed using sputtering technology.

37. (Original) The method of Claim 36, wherein the second barrier metal layer comprises titanium nitride (TiN), titanium silicon nitride (TiSiN), tantalum silicon nitride (TaSiN) and/or tantalum nitride (TaN).

38. (Original) The method of Claim 24, wherein forming the barrier metal layer and flushing the barrier metal layer are repeated at least once.

APPENDIX B – EVIDENCE APPENDIX

None

APPENDIX C – RELATED PROCEEDINGS APPENDIX

None.